MAKING ELECTRICAL CONNECTION OF INSTRUMENT PANEL WIRING TO BODY AND ENGINE COMPARTMENT WIRING DURING THE INSTRUMENT PANEL INSTALLATION

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to vehicle assembly systems, and more particularly, to an apparatus and method for installing an instrument panel assembly in an automotive vehicle body.

BACKGROUND AND SUMMARY OF THE INVENTION

A substantial amount of manual labor is still required in the assembly of automobiles. To the extent that mechanical and power equipment can be employed in these processes, less time and physical labor are required, and fewer injuries are incurred.

The apparatus of the present invention is especially adapted to transfer an instrument panel assembly to a moving vehicle body in an assembly line in an automobile assembly plant and install it in the body.

Currently, vehicles are designed such that the body and engine compartment wiring connections must be manually made into the instrument panel wiring after the instrument panel is installed in the vehicle. The process of manually mating the instrument panel wiring with the body and engine compartment wiring requires additional manpower to perform operations which are not ergonomically friendly. The apparatus of the present invention is adapted for use with a self-docking instrument panel connector system whereby the electrical connection from a vehicle's instrument panel wiring to its body and engine compartment wiring is improved by eliminating the need to manually mate the wiring connectors together. The improved instrument panel connector system has a stationary connector and an adjustable connector. The connector system compensates for build tolerances and component insertion variances

automatically. The adjustable connector is capable of moving in three axes, as well as being capable of limited rotational movement. The ability of the adjustable connector to move in all three axes, as well as having limited rotational movement, facilitates an improved mating arrangement between the adjustable connector and the stationary connector as the instrument panel is installed in the vehicle.

The instrument panel installation system, according to the present invention, provides an electrical connector having a first connector member supporting a plurality of electrical terminals mounted to an instrument panel. A second connector member supports corresponding electrical terminals for mating with the plurality of electrical terminals supported by the first connector member. The second connector member is supported by the vehicle body. The instrument panel installation system is utilized for installing the instrument panel assembly within the vehicle body while the first and second connector members are aligned with one another. The installation system then applies an additional engagement force for engaging the first and second connector members.

Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood however that the detailed description and specific examples, while indicating preferred embodiments of the invention, are intended for purposes of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

Figure 1 is a semi-diagrammatic top plan view with parts broken away of apparatus constructed in accordance with the invention;

Figure 2 is a fragmentary perspective view of a portion of the swing frame assembly according to the present invention;

Figure 3 is a detailed perspective view of the swing frame assembly according to the present invention;

Figure 4 is a perspective view illustrating the assembly of the instrument panel within the vehicle according to the principles of the present invention;

Figure 5 is a perspective view of the rear of the instrument panel assembly according to the principles of the present invention;

Figure 6 is a perspective view of the front of the passenger compartment where a connector mounting bracket is mounted;

Figure 7 is an exploded perspective view of a wire harness coupler embodying the present invention;

Figure 8 is an exploded side view of the instrument panel connector system of the present invention;

Figure 9 is a perspective view of the electrical connector according to the principles of the present invention;

Figure 10 is a front view of an outer bracket for use with the present invention;

Figure 11 is an end view of the outer bracket shown in Figure 4;

Figure 12 is a side view of the outer bracket shown in Figure 4;

Figure 13 is a front view of a snap lock for enclosing the outer bracket of the present invention;

Figure 14 is a top view of the snap lock shown in Figure 7;

Figure 15 is a cross-sectional view taken along line 9-9 of Figure 8;

Figure 16 is a front view of an inner bracket of a connector holding assembly;

Figure 17 is a side view of the inner bracket shown in Figure 10;

Figure 18 is an end view of the inner bracket shown in Figure 10;

Figure 19 is a perspective view of a 25-way connector assembly;

Figure 20 is a cross-sectional view of a connector holding assembly according to the principles of the present invention;

Figure 21 is a cross-sectional view illustrating the engagement of the stationary or fixed connector with the inner bracket of the adjustable connector assembly;

Figure 22 is a cross-sectional view illustrating the stationary connector engaged with the inner bracket of the adjustable connector assembly;

Figure 23 is a cross-sectional view illustrating the connection of a male and female connector supported by the stationary or fixed connector and one of the inner connectors of the adjustable connector assembly; and

Figure 24 is a cross-sectional view illustrating the stationary or fixed connector engaged with the inner bracket or the adjustable connector assembly and with the prongs of the outer bracket being recessed in the holes of the mounting surface.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to Figures 1-6, the apparatus for transferring an instrument panel assembly from a pick-up station to the interior of an automobile vehicle body for installation will be described. Automotive car bodies B are shown individually mounted on body carriers 10 which are moved along an assembly line 12 in longitudinally

spaced apart relation by any suitable means (not shown). The car bodies B are disposed lengthwise of the direction of movement of the assembly line 12. Instrument panel assemblies IP are adapted to be transferred from a pick-up station 16 spaced laterally to one side of the assembly line 12 and installed in the moving car bodies B. The instrument panel assemblies IP are transferred by a swing frame assembly 18 which is mounted on a bridge 20 for transverse movement from the pick-up station 16 to the assembly line 12. The moving car body carriers 10 each have a vertical post 14 for contacting an arm connected to the bridge 20 and moving the bridge along track 22 in unison with the car bodies B so that the instrument panel assemblies IP can be transferred while the car bodies are moving. Track 22 consists of rails 23 which are parallel to the assembly line 12 and are engaged by rollers on the bridge 20.

The pick-up station 16 is located at a point along a rail 24 which is parallel to, and laterally spaced from, the assembly line 12 along which the car bodies travel. A fixture for carrying an instrument panel assembly is mounted on a trolley 28 which has rollers engaging the rail 24. The trolley 28 is moved along the rail 24 by any suitable means. The trolley system 28 as utilized in the present invention is disclosed in U.S. Patent No. 5,456,002 assigned to the assignee of the present application, and is hereby incorporated by reference.

With reference to Figures 1 and 2, the swing frame assembly 18 has a carriage 30 provided with roller units 32 engaging the parallel rails 34 of the bridge 20 to enable the carriage 30 to move along the bridge 20 from a position adjacent the pick-up station 16 to a position adjacent to the assembly line 12. Affixed to the bottom of the carriage 30 is a head 36 to which a horizontal circular break disk 38 is secured. An elongated vertical column 98

extends downwardly from the head 94 and is pivoted thereto for axial rotation. An articulated arm assembly projects radially outward from column 40 and has a pair of parallel arms 42 secured at one end to a bracket 44 on the column 40 for vertical swinging movement on pins 46 and 48. The opposite ends of the arms 42 are connected to an upright bracket 50 for vertical pivotal movement on pins 52 and 54. The pins 46, 48, 52 and 54 are arranged in a rectangular pattern on parallel axes so that the arms 42 form a parallelogram linkage and pivot up and down as a unit while the upright bracket 50 at the end of the arms 42 remains at all times in the same upright position.

Projecting generally horizontally from the upright bracket 50 is a beam 56 which carries various instruments for guiding the beam in the proper position to pick up an instrument panel assembly IP on a fixture at the pick up station 16, for supporting the instrument panel IP on the beam 56 and temporarily securing it thereto, and for securing the instrument panel assembly IP to the frame of an automobile body B. The beam 56 is connected to the bracket 50 for pivotable adjustment by horizontal hinge 58, such pivotable adjustment being effected by a piston-cylinder assembly 60. The beam 56 is usually kept in a horizontal position, but occasionally it is necessary to pivotally adjust the beam 56 because the car body B in which the instrument panel assembly IP is installed sometimes is tipped or inclined away from the horizontal slightly to one side or the other and the beam 56 should be similarly inclined. The beam 56 must be located with precision when it receives an instrument panel assembly IP from the fixture on a trolley 28 at the pick-up station 16. The beam 56 has laterally spaced rests 62 and 64 mounted on brackets secured to, and extending from, the beam 56. The beam 56 also has a clamping device 66 between rests 62 and 64.

With reference to Figure 3, a tool housing 68 is rigidly mounted on beam 56 adjacent one end thereof and has a fastener driver 70 pointing forwardly for inserting a fastener into a prepared hole in the instrument panel assembly IP. A tool motor on the housing 68 operates the driver 70 to set the inserted fastener in the frame of the car body B as more fully described hereinafter. Also mounted on housing 68 is a forwardly projecting locating pin 72 which extends into a hole in the instrument panel assembly IP for locating purposes.

Another tool housing 78 is rigidly mounted on beam 56 adjacent the opposite end thereof, and has a fastener driver 80 pointing forwardly for inserting a fastener into a hole in the instrument panel assembly IP. A tool motor operates the driver 80 to set the inserted fastener in the frame of the car body B.

Also mounted on the housing 78 is a forwardly projecting locating pin 82 which extends into a hole in the instrument panel assembly IP for locating purposes. The beam 56 can be raised and lowered manually. An air balancing piston-cylinder assembly 84 connected at one end to the column 40 and at the other end to one of the arms 42 will maintain the beam 56 at whatever elevation the operator selects.

A control panel 86 for the swing frame assembly is mounted on the beam 56 and provides the operator with the controls for operating the tool motors 68 and 78 and the cylinder assemblies. The control panel 86 is adjacent to the operator handles 88.

The swing frame assembly 18 can be swung from a position in which the beam 56 is parallel to the fixture at the pick-up station 16 (dotted lines in Fig. 1) to a position in which the beam 56 is at right angles thereto (solid lines in Fig.1). Stops are provided on the brake disk 38 to determine these two positions by engagement with

an arm on column 40. When the arm strikes a stop as the swing frame assembly reaches the position in which the beam is at right angles to the pick up station, the arm also engages and actuates a limit switch which operates the brake pads to engage the brake disk 38 and prevent further rotation of the swing frame assembly 18. This system is described in greater detail in U.S. Patent No. 5,456,002.

As previously stated, when the swing frame assembly 18 is in the process of inserting an instrument panel assembly IP into a moving car body B on the assembly line 12, the bridge 20 in which the swing frame assembly 18 is mounted moves in unison with the car body B. For this purpose, the bridge 20 is connected to a second bridge 92 by piston-cylinder assemblies 94. Bridge 92 extends parallel to bridge 20 and has roller units 96 engaging the rails 23 of track 22 for movement therealong. Bridge 92 has two arms 98, 100 which are normally swung apart to aligned positions paralleling the path of the assembly line 12 but which can be individually swung 90 degrees toward one another by piston cylinder assemblies 102 and 104 so that they are parallel and point toward the assembly line 12. In the later positions, they cross the paths of the vertical post 14 on the body carrier 10. The operator extends arm 98 by means of one of the controls on panel 86. Arm 100 is extended in response to a limit switch on arm 98 being contacted by a post 14 on a car body carrier 10. Piston-cylinder assemblies 94 are operated by control switches 106, 108 next to handle 88 to move bridge 20 closer to (switch 106), or farther from (switch 108), bridge 92 as desired.

To take an instrument panel assembly IP from the pick-up station 16, the operator turns the swing frame assembly 18 to a position in which the stop is engaged and the beam 56 is generally parallel to the rail 24 along which trolley 28 moves. The operator moves the carriage 30 of the swing

frame assembly along bridge 20 toward the pick-up station 16, and manipulates the beam 56 so that the instrument panel assembly will become supported on rests 62 and 64. Also, the fasteners and locator pins 72, 82 will be projected through holes in the instrument panel assembly IP. The instrument panel assembly IP is also engaged by clamping device 66. The instrument panel assembly IP is then released from the fixture so that the operator may move the beam 56 and instrument panel assembly away from the fixture.

The swing frame assembly 18 with the instrument panel assembly IP is swung approximately 90 degrees so that the beam 56 is perpendicular to the pick-up station 16 and the arm strikes the stop, as discussed above, to limit further swinging movement of the swing frame assembly.

By means of a switch at the control panel 86, the operator actuates the cylinder 102 to extend arm 98 into the path of the post 14 on car body carriers 10. The post of the next body carrier 10 will engage arm 98, and the limit switch on arm 98 when contacted by the post will actuate cylinder 104 to extend arm 100 and thus entrap the post between the arms. The bridge 20 will thereupon move with the body carrier 10 and the swing frame assembly 18 will of course move with the bridge 20.

The operator manually advances the swing frame assembly 18 along bridge 20 toward the assembly line 12 and manipulates the beam, carrying the instrument panel assembly IP, into the open side of a car body B (the doors are not on the car body at this stage of production). A second operator on the opposite side of the car body may use handles 110 to assist in maneuvering the beam 56 into position for installation of the instrument panel assembly IP.

As described below with reference to Figures 5-24, the instrument panel assembly IP is provided with an instrument

panel to body wiring connector 112 which is mounted to the rear of the instrument panel assembly IP. The connector 112 is mounted to the instrument panel IP by a mounting bracket 114 which includes a pair of ears 116. The self docking instrument panel connector system of the present invention allows the connection of the wire harness 118 of the instrument panel IP to be connected to the body and engine compartment harnesses 120 automatically when the instrument panel IP is connected to the body of the vehicle B. The self docking instrument panel connector system includes a stationary or fixed connector 112 which is mounted to the instrument panel assembly IP. The fixed connector 112 engages an inner bracket 121 of a connector holding assembly 122. Connector holding assembly 122 includes an outer bracket 124 which supports inner bracket 121. Outer bracket 124 is mounted to optional mounting bracket 126 or to the vehicle body B. The stationary or fixed connector 112 is provided with a pair of mounting portions 134 which can be connected to the instrument panel IP by a bracket such as bracket 114. The stationary or fixed connector 112 can be fastened to bracket 114 by screws 130, bolts, or other means.

Inner bracket 121 supports a plurality of inner connector assemblies 132 which include a plurality of female terminals 136, as shown in Figure 19, which are connected to respective wires on the wire harnesses 120. A plurality of male terminals 138 are supported by the outer connector 112. The male terminals 138 are connected to individual wires 140 of wire harness 118. The wire harness 118 is connected to a plurality of connectors 142 which are disposed within the instrument panel IP for delivering electrical signals to and from a plurality of instrument panel actuators and displays.

Outer connector 112 is provided with a funnel surface 143, best seen in Figure 21, which engages an upper surface

144 of inner bracket 121 and properly centers inner bracket 121 with respect to the seating portion 146 of outer connector 112. The male terminals 138 supported by the stationary or fixed connector 112 engage with female terminals 136 of a connector assembly 132 as shown in Figures 23 and 24. According to a preferred embodiment, inner bracket 121 is provided with three pockets 148 for supporting three connector assemblies 132. Pockets 148 are defined by outer wall 150 and center walls 152 of the inner bracket 121.

Connector assemblies 132 are provided with a latching mechanism 154, each having a locking member 156 which engages a locking tab 158 disposed on the outer wall 150 of inner bracket 121. Inner bracket 121 includes a flanged portion 160 received in a slot 162 of outer bracket 124. Inner bracket 121 is also provided with a plurality of lateral spring members 164 which extend laterally outward from an upper portion of outer wall 150. Spring members 164 extend downward toward flange 160. Flange 160 includes a plurality of openings 166 which receive an end of lateral spring members 164. Lateral spring members 164 engage an inner surface 168 of outer bracket 124 adjacent to slot 162. Lateral spring members 164 bias inner bracket 121 to a centered position relative to outer bracket 124. However, lateral spring members 164 are flexible to enable adjustment of the positioning of inner bracket 121 relative to outer bracket 124 as illustrated in Figure 20. Thus, the lateral position of inner bracket 121 is automatically adjustable for aligning itself with outer connector 112 in the *x* and *y* lateral directions shown in Figure 9.

Outer bracket 124 includes a plurality of prongs 170 which are each provided with a plurality of crush ribs 172 along a radial surface thereof. Prongs 170 are provided with a pointed tip 174 having a seat portion 176. The pointed tip 174 of prongs 170 are inserted into holes 178

of a mounting surface 180. During the assembly of the instrument panel IP to the vehicle body B, there are many tolerances which must be accounted for during connection of the stationary or fixed connector 112 to inner bracket 121 of connector holding assembly 122. These tolerances exist in all three dimensions (x,y,z), and therefore require that the inner bracket 121 be movable in all three directions (x,y,z). Therefore, the inner bracket 121 is adjustable relative to outer bracket 124 in two lateral dimensions (x,y) due to the flange 160 being movable in slot 162 of outer bracket 124. In addition, prongs 170 are capable of being adjustably seated in holes 178 (in the z direction) of mounting surface 180, as illustrated in Figure 24. In particular, when prongs 170 are pushed or forced into holes 178 of mounting surface 180, the crush ribs 172 are shaved away from prongs 170. Alternatively, crush ribs 172 can merely deform upon insertion through holes 178. The ability of the prongs 170 to be adjustably seated in holes 178 of mounting surface 180 allow the inner bracket 121 to move in the longitudinal (z) direction when the instrument panel IP is assembled to the vehicle body B, and outer connector 112 has been fully mated with inner bracket 121.

Outer bracket 124 includes a main bracket portion 124a (illustrated in Figures 10-12) and a snap lock bracket portion 124b (illustrated in Figures 13-15). Main bracket portion 124a is provided with a pair of latch fingers 182 which are received in finger receptors 184 of snap lock bracket portion 124b. Latch fingers 182 are provided with a slot 186 which is engaged by locking tab 188 disposed within finger receptor 184. Snap lock bracket portion 124b also includes a plurality of guide teeth 190 which are received in tooth receptor portions 192 of main bracket portion 124a. Because snap lock bracket portion 124b is removable from main bracket 124a of outer bracket 124,

inner bracket 121 can be removed from outer bracket 124 for maintenance.

During assembly of an instrument panel IP into a vehicle body B, the connector holding assembly 122 is mounted to the vehicle body or another mounting surface provided with holes for receiving prongs 170 of outer bracket 124. Inner bracket 121 is provided with a plurality of connector assemblies 132, as needed, and wire harnesses 120 are connected to the connector assemblies 132. Stationary or fixed connector 112 is mounted to the instrument panel assembly IP and is provided with a plurality of terminals attached to various wires of wire harness 118.

Prior to installing the instrument panel assembly IP, the instrument panel IP is properly aligned by the first and second operators. When this has been accomplished, the cylinder assemblies 94 of the assembly system are actuated by the first operator using controls on panel 86 to advance the bridge 20 forwardly relative to bridge 92. As the instrument panel IP is brought toward its mounting position in vehicle body B funnel surface 143 of stationary or fixed connector 112 engages the upper surface 144 of the outer wall 150 of inner bracket 121. If the stationery or fixed connector 112 and inner bracket 121 are not properly aligned, funnel surface 143 will guide inner bracket 121 to a properly aligned position whereby lateral spring members 164 allow lateral adjustment of inner bracket 121 relative to outer bracket 124 in the x and y lateral directions. As the instrument panel to body wiring connector assembly 112, 121 is aligned, the cylinder assemblies 94 are required to apply an additional force for engaging the electrical connectors together. As the stationary or fixed connector 112 is brought into complete contact with inner bracket 121 lateral spring members 164 are fully received within spring recess portions 198 of stationary or fixed connector 112,

as shown in Figure 22. As the instrument panel IP is fully assembled to the vehicle body B, the variances in the longitudinal (z direction) positioning of stationary or fixed connector 112 relative to inner bracket 121 can be compensated by prongs 170 of outer bracket 124 being adjustably seated longitudinally in holes 178 of mounting surface 180. Thus, the connector holding assembly 122 enables movement of inner bracket 121 in two lateral directions (x and y) relative to outer bracket 124. In addition, the ability of prongs 170 to be adjustably seated, allows the instrument panel connector system to be adjustable in the longitudinal (z) direction.

Each electrical connector has approximately 75 terminals which engage a corresponding terminal on the other connector. Each terminal requires approximately one pound of force in order to properly insert the male terminal into the female terminal. Accordingly, an added force of between 75 and 100 pounds is required for a 75-terminal connector in order to properly engage the instrument panel to body wiring connector 112, 121. As the cylinder assemblies 94 are actuated by the first operator using controls on panel 86 to advance the bridge 20 forwardly relative to bridge 92, the connector assemblies become properly engaged and the instrument panel IP assumes a properly installed position.

When in properly installed position, the instrument panel assembly IP is secured to the frame of the autobody B by operation of tool motors 68 and 78 to drive fasteners into the frame of the body B. After the instrument panel assembly IP has been installed and secured in the car body B by the swing frame assembly 18, the clamping device 66 is released and the swing frame assembly 18 is manually withdrawn from the car body B. The operator using a control on control 86 causes the cylinder assembly 102 to retract the arm 98 thereby releasing the post 14 on the car

body carrier 10 so that the bridge 20 and swing frame assembly 18 no longer move with the advancing car body B. When arm 98 swings to its released position, the limit switch on arm 98 is released causing the cylinder 104 likewise to retract the other arm 100.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.